

Center for Design of Analog-Digital Integrated Circuits (CDADIC)

Washington State University, University of Washington, Oregon State University, and State University of New York at Stony Brook

Electronic design and manufacturing industries benefit from advances in mixed analog-digital design technology.

Center Mission and Rationale

Analog-digital (mixed mode) integrated circuit designs have important applications in many fields, including avionics, space technology, and medical electronics. Technical advantages of using mixed analog-digital circuitry range from enhanced performance to improved miniaturization of products. Presently, electronic systems with combined analog-digital circuitry are difficult to simulate, test, and repair. Computer-aided design and simulation for these mixed-mode circuits are not as automated and refined as for single-mode, digital circuits.

The Center for Design of Analog-Digital Integrated Circuits (CDADIC) is a consortium of three Northwest research universities and one in New York state. CDADIC headquarters are at Washington State University. One of CDADIC's 19 sponsors is the Washington Technology Center, a state-sponsored industry-university cooperative enterprise created by the Washington State Legislature to foster private and federal investment in research and technology with commercial potential.

CDADIC's mission is to advance the state-of-the-art for design tools, testing techniques, and circuit design methodologies for analog and analog-digital integrated circuits. The Center has made significant progress toward giving U.S. electronic design and manufacturing industries access to analog and analog-digital design technology that is as reliable and effective as pure digital technology.

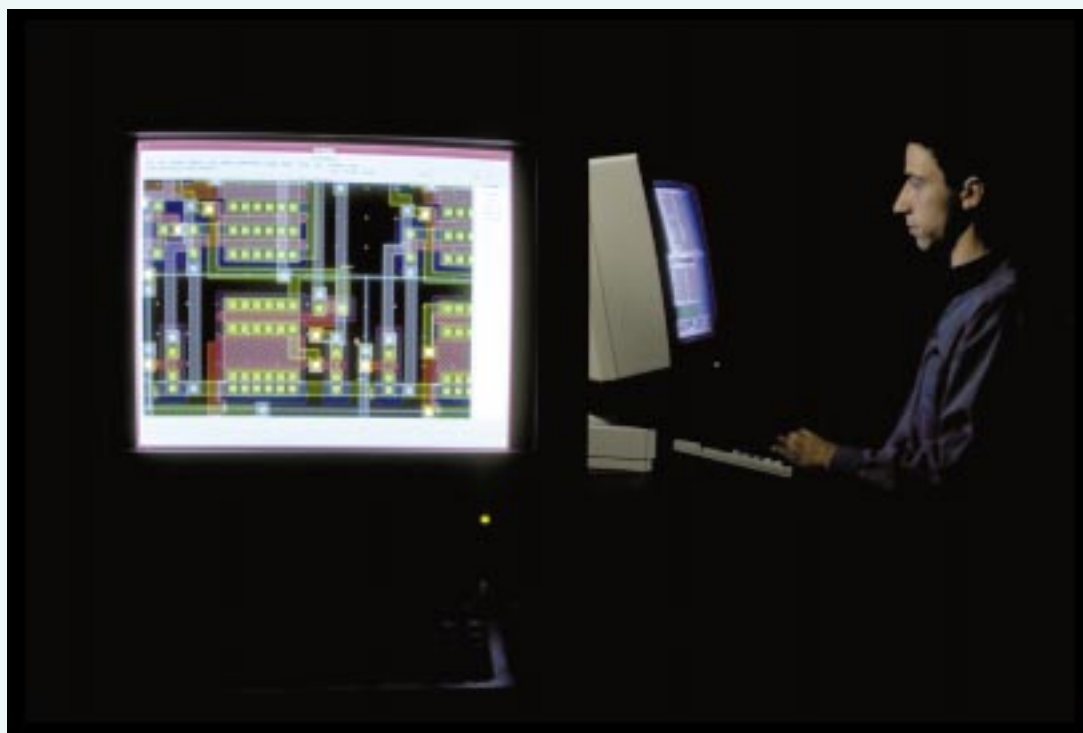
Among the Center's goals are to —

- Develop new computer-aided engineering (CAE) technology to enhance analog and analog-digital circuit designs
- Further develop the methodology for analog-digital integrated circuit design and testing.

Research Program

CDADIC is one of the few research centers in the country that address problems associated with combining analog and digital integrated circuitry on a common chip. Five research thrusts characterize the focus of the Center:

A National
Science
Foundation
Industry/
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Research
Center
since 1989



Russell Croman, a Washington State University graduate student working with CDADIC researchers in the area of circuit design, uses Mentor Graphic's newest CAD toolset, installed on a Hewlett-Packard workstation, for his graduate work.



Terri Fiez, CDADIC researcher and recent recipient of a National Science Foundation Young Investigator Award, talks with her graduate students about an integrated circuit they are testing.

- **Modeling** — Constructing accurate computer models of circuits, devices, and interconnects for applications requiring high temperature and power, or high speed and frequency
 - **Design methodology** — Developing systematic methods for design, which incorporate the reuse of existing designs, module generation, and automatic layout of analog-digital integrated circuits
 - **Simulation** — Developing methodologies to evaluate, test, and characterize new and existing circuit simulators; improving speed and efficiency for analog-digital simulation through use of hardware accelerators with hierarchical simulators using parametric yield optimizers
 - **Circuit design** — Developing new mixed-mode circuit designs for high-precision, low-voltage, ultra-low voltage, and high-speed applications; examples include a recently patented logic family, analog BiCMOS, current-mode, and switched-current designs
 - **Testability** — Applying statistical pattern analysis to parametric fault diagnosis in mixed-signal systems and microcircuits; integrating on-chip parametric testability into the design phase for analog circuits.
- acceleration, low-power CMOS analog-digital conversion, and high-temperature electronics.
 - Collaboration with Boeing has provided the company with a prototype design of a Sigma-Delta A-D converter and test use of in-hand ICs with Sigma Delta Modulators on them.
 - Sandia National Laboratories in New Mexico is developing a CHFET process with contributions from CDADIC researchers working on the project "Analog IC Design Using Complementary HFETS." A CDADIC researcher took a year's sabbatical leave at Sandia to implement analog designs in the developmental CHFET process.
 - New power diode models developed by CDADIC researchers have been transferred to CDADIC sponsors Analog and Mentor Graphics and, after becoming public domain, to Intusoft and Siemens AG.
 - BiCMOS mixed-signal cell design techniques have been imported by Boeing for use in a range of applications, including power supplies, controllers, and commercial avionics.

CDADIC projects have achieved national and world recognition in analog and analog-digital application-specific integrated circuit (ASIC) design. The Center has served as a catalyst for capturing innovative research and educational opportunities for university members and industrial partners. Some of

these include —

- Enhanced educational opportunities for electrical engineering, computer engineering, and computer science students including new, updated, or restructured university courses; updated computing and other laboratory equipment; and wider opportunities for student internships and other forms of student-industry interaction
- Participation in innovative educational programs such as Research Experiences for Undergraduates and Research at Undergraduate Institutions
- Completion of a new high-temperature test facility at Washington State University, which has been well-used by industry for testing product components that need to withstand temperatures up to 350°C.

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Special Center Activities

The Center has transferred important technologies to industry. Examples are listed below:

- CDADIC projects have provided ELDEC/ Crane with needed updates on simulation